IS 150 GY OVERKILL FOR CARIBBEAN FRUIT FLY LARVAE?

Burrell Smittle

The use of generic irradiation doses as reported in recent regulations is a step in the right direction. However, the emphasis on dosimetry at the recent APHIS/NAPPO workshop in Tampa, Florida, indicates how far this aspect has progressed in the last few years. Most researchers studying the effect of irradiation on insects in the last 40 years were told by the manufacturer of the irradiation device what the dose rate was, or the RSO or someone else did and it was reported as fact. Some questions were frequently asked about Roentgen or Rad, average dose ± or minimum dose ± SD, etc. The USDA made an effort to assure that all USDA irradiators were checked by Fricke dosimetry every few years, but this was not always satisfactory. With the current availability of 6 ASTM reference standard dosimeters and 11 routine dosimeters plus NIST and other national and international calibration verification laboratories, every user of irradiation devices should use dosimeters regularly and have their irradiator dosimetry equipment calibrated to a national standard. After all irradiator calibrations are referenced to a national standard, it will be possible to make a better comparison of irradiation results from different laboratories.

Most of the irradiation research on the Caribbean fruit fly, *Anastrepha suspensa,* has been in Gainesville or Miami, Florida, in Cobalt-60 or Cesium-137 sources at USDA laboratories. In addition, irradiation of grapefruit infested with Caribbean fruit fly (CFF) larvae was done in New Mexico and New Jersey. Since the completion of the mass rearing facility in Gainesville, it has been possible to irradiate large numbers of larvae and pupae for research programs. The release of *Diachasmimorpha longicaudata,* a parasitic wasp in a biological control program has used over a billion third instar larvae irradiated in Cobalt-60, Cesium-137, X-ray, and electron beam facilities.

The two Cesium- 13 7 sources and the Cobalt-60 source have been in use since the early 1970s and the dose rate is based on source manufacturers and Fricke dosimetry. The Cobalt-60 source is no longer available, but the dose rates of two Cesium sources have been calibrated to compare the Fricke (F) dose in air, corrected for decay, to the Gafchromic (GAF) film dose, referenced to NIST standards, in a canister of larvae. The majority of irradiations were conducted with a Cesium-13 7 (Gammacell^{R}1000) with a 3 inch diameter chamber 8 inches high. We used a plastic container with a volume of 800 ml to hold about 42,000 larvae for irradiation. We have determined that the dose (GAF) at the lowest level in the cannister filled with larvae is 75% of the air dose (F). We have continued to use 60 Gy as the dose given to larvae so that this will compare to studies done in the past 25 years in the same source, but knowing that the minimum dose the larvae are receiving is 45 Gy. Tests were conducted with full canisters of larvae and no adults emerged after 40 Gy F (30 Gy GAF) or 50 Gy F (37.5 Gy GAF) and <1% emerged after 30 Gy F (22.5 Gy GAF).

We have used 60 Gy F (45 Gy GAF) as the dose to irradiate over I billion larvae in the parasite rearing program without any adult fly emergence. In this rearing procedure, the female wasp oviposits in the CFF larvae, the CFF larvae pupates and the pupae are held for emergence of parasite adults. In this rearing system, the emergence of any CFF adults would be observed as they would emerge before the parasite adults. Also, we have irradiated CFF larvae in a linear accelerator using both electrons and X-rays. Bags of 2 or 3 liters of larvae were placed in trays, exposed to 60 Gy GAF, placed in vermiculite to pupate and checked for any adult emergence. No adult emergence was observed.

Since the current minimum dose recommendation for CFF larval treatment is 150 Gy, our research indicates that it is about 3 times too high. If this is true for CFF, it may be true for other fruit flies also. I think we need more large scale tests on other fruit flies using irradiation sources and dosimetry methods calibrated to NIST or other international standards. This becomes important when faced with possible fruit damage as with early grapefruit that can occur as low as 250 Gy. With a max/min of 3, a minimum dose of 50 Gy would keep the maximum dose below the level to cause damage while a minimum dose of 150 Gy and a maximum dose of 450 Gy would cause damage. I would like to see a high priority placed on establishing new minimum dose rates for all fruit flies using new research data with traceable dose rates and ASTM standards.